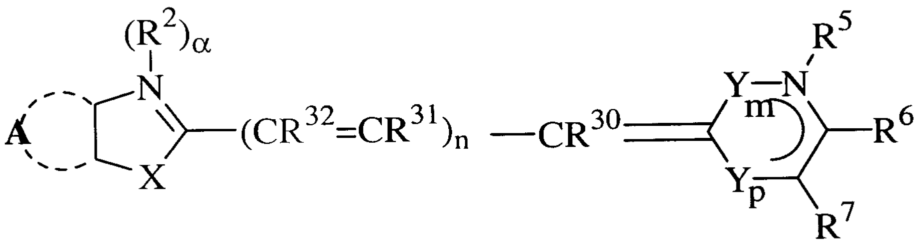
CLAIMS

What is claimed is:

1. A method for determining the presence of an analyte of interest in a sample, wherein said method comprises:

a) combining said sample with a staining solution, wherein said staining solution comprises one or more dyes having formula



Formula I

wherein A represents the atoms necessary to form one to two fused aromatic rings having 6 atoms in each ring, at least one of which is a nitrogen atom, said ring or rings being optionally further substituted one or more times by C_1-C_6 alkyl, C_1-C_6 alkoxy trifluoromethyl, halogen, BRIDGE, -L-Rx or -L-Sc;

wherein Rx is a reactive group; Sc is a conjugated substance; and L and BRIDGE are independently a single covalent bond, or a covalent linkage;

X is O, S, Se, NR^{15}, or $CR^{16}R^{17}$, where R^{15} is H or an alkyl group having 1-6 carbons; and R^{16} and R^{17}, which may be the same or different, are independently alkyl groups having 1-6 carbons, or R^{16} and R^{17} taken in combination complete a five or six membered saturated ring;

R^2 is selected from the group consisting of –L-Rx, -L-Sc, TAIL, BRIDGE and an alkyl group having 1-6 carbons that is optionally substituted by sulfo, carboxy, amino, substituted amino or substituted ammonium, wherein α is 0 or 1; and TAIL is a heteroatom-containing moiety;

Y is $-CR^3=CR^4-$ wherein p and m = 0 or 1, such that p + m = 1;

R^3, R^4, R^6, and R^7 are independently selected from the group consisting of hydrogen, a C_1-C_6 alkyl, a halogen, a CYCLIC SUBSTITUENT, $-OR^8$, $-SR^8$, $-(NR^8R^9)$, TAIL; BRIDGE, -L-Rx and –L-Sc; where R^8 and R^9 are independently a C_1-C_6 alkyl group, 1-2 alicyclic or aromatic rings; or R^8 and R^9 taken in combination are $-(CH_2)_2-V-(CH_2)_2-$ where V is a single bond, -O-, $-CH_2-$, or $-NR^{10}-$, where R^{10} is H or an alkyl having 1-6 carbons;

wherein CYCLIC SUBSTITUENT is a substituted or unsubstituted aryl, heteroaryl or C_3-C_{10} cycloalkyl;

or R^6 and R^7 form a fused aromatic ring $-R^{11}=R^{12}-R^{13}=R^{14}-$ wherein R^{11}, R^{12}, R^{13}, and R^{14} are independently selected from the group consisting of hydrogen, C_1-C_6 alkyl group, $-OR^8$, $-SR^8$, $-(NR^8R^9)$,a CYCLIC SUBSTITUENT, TAIL, BRIDGE, -L-Rx and –L-Sc;

R^5 is independently selected from the group consisting of a C_1-C_6 alkyl group, a CYCLIC SUBSTITUENT, TAIL, BRIDGE, -L-Rx and –L-Sc; or R^5 is absent;

R^{30}, R^{31}, and R^{32} are independently selected from the group consisting of hydrogen, C_1-C_6 alkyl, C_3-C_{10} cycloalkyl, aryl, and heteroaryl, wherein n = 0, 1 or 2;

wherein, BRIDGE, when present, is bound to a compound having formula I or another unsymmetrical cyanine dye

b) incubating said sample and said staining solution for a sufficient amount of time to form a dye-analyte complex;

c) illiminating said complex with an appropriate wavelength whereby the presence of said analyte is determined.

2. The method according to Claim 1, wherein said analyte of interest is a poly(amino acid) or a nucleic acid.

3. The method according to Claim 2, wherein said poly(amino acid) is in solution or immobilized on a solid or semi solid matrix.

4. The method according to Claim 3, wherein said matrix is a polymeric gel, an array, a polymeric microparticle or a membrane.

5. The method according to Claim 4, wherein said gel is a polyacrylamide gel.

6. The method according to Claim 3, wherein said method further comprises heating said sample prior to combining with said staining solution, or heating combined sample and staining solution mixture.

7. The method according to Claim 3, wherein said method further comprises removing, destroying, or dispersing below the critical micelle concentration any biological membranes that are present in said sample.

8. The method according to Claim 3, wherein said method further comprises adding an anionic detergent to the sample, staining solution or combined sample and staining solution mixture.

9. The method accoridng to Claim 2, wherein said nucleic acid is in solution, immobilized on a solid or semi-solid matrix or present in a biological structure.

10. The method according to Claim 9, wherein said matrix is a polymeric gel, an array, a glass slide, a polymeric microparticle or a membrane.

11. The method according to Claim 10, wherein said gel is an agarose gel.

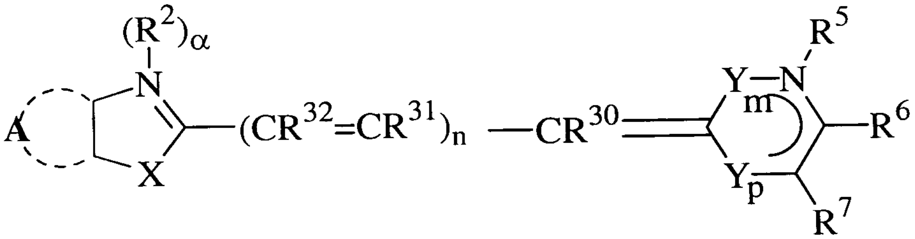
12. The method according to Claim 9, wherein said biological structure is a biological cell, a

virus particle or a tissue section.

13. A method for the detection of immobilized poly(amino acids), wherein method comprises:

a) immobilizing said poly(amino acids) on a solid or semi-solid matrix;

b) combining said said sample with a staining solution prior, during or after immobilization of said poly(amino acid), wherien said staining solution comprises a compound having formula



Formula I

wherein A represents the atoms necessary to form one to two fused aromatic rings having 6 atoms in each ring, at least one of which is a nitrogen atom, said ring or rings being optionally further substituted one or more times by C_1-C_6 alkyl, C_1-C_6 alkoxy trifluoromethyl, halogen, BRIDGE, -L-Rx or -L-Sc;

wherein Rx is a reactive group; Sc is a conjugated substance; and L and BRIDGE are independently a single covalent bond, or a covalent linkage;

X is O, S, Se, NR^{15}, or $CR^{16}R^{17}$, where R^{15} is H or an alkyl group having 1-6 carbons; and R^{16} and R^{17}, which may be the same or different, are independently alkyl groups having 1-6 carbons, or R^{16} and R^{17} taken in combination complete a five or six membered saturated ring;

R^2 is selected from the group consisting of –L-Rx, -L-Sc, TAIL, BRIDGE and an alkyl group having 1-6 carbons that is optionally substituted by sulfo, carboxy, amino, substituted amino or substituted ammonium, wherein α is 0 or 1; and TAIL is a heteroatom-containing moiety;

Y is $-CR^3=CR^4-$ wherein p and m = 0 or 1, such that p + m = 1;

R^3, R^4, R^6, and R^7 are independently selected from the group consisting of hydrogen, a C_1-C_6 alkyl, a halogen, a CYCLIC SUBSTITUENT, $-OR^8$, $-SR^8$, $-(NR^8R^9)$, TAIL; BRIDGE, -L-Rx and –L-Sc; where R^8 and R^9 are independently a C_1-C_6 alkyl group, 1-2 alicyclic or aromatic rings; or R^8 and R^9 taken in combination are $-(CH_2)_2-V-(CH_2)_2-$ where V is a single bond, -O-, $-CH_2-$, or $-NR^{10}-$, where R^{10} is H or an alkyl having 1-6 carbons;

wherein CYCLIC SUBSTITUENT is a substituted or unsubstituted aryl, heteroaryl or C_3-C_{10} cycloalkyl;

or R^6 and R^7 form a fused aromatic ring $-R^{11}=R^{12}-R^{13}=R^{14}-$ wherein R^{11}, R^{12}, R^{13}, and R^{14} are independently selected from the group consisting of hydrogen, C_1-C_6 alkyl group, $-OR^8$, $-SR^8$, $-(NR^8R^9)$,a CYCLIC SUBSTITUENT, TAIL, BRIDGE, -L-Rx and –L-Sc;

R^5 is independently selected from the group consisting of a C_1-C_6 alkyl group, a CYCLIC SUBSTITUENT, TAIL, BRIDGE, -L-Rx and –L-Sc; or R^5 is absent;

R^{30}, R^{31}, and R^{32} are independently selected from the group consisting of hydrogen, C_1-C_6 alkyl, C_3-C_{10} cycloalkyl, aryl, and heteroaryl, wherein n = 0, 1 or 2;

wherein, BRIDGE, when present, is bound to a compound having formula I or another unsymmetrical cyanine dye

c) incubating said sample and said staining solution for a sufficient amount of time to form a dye-poly(amino acid) complex;

d) illiminating said complex with an appropriate wavelength whereby the presence of said poly(amino acid) is determined.

14. The method according to Claim 13, wherein said compound is overall neutral in charge.

15. The method according to Claim 14, wherein said R^2 is a C_2-C_6 alkyl group substituted by a sulfo group or R^5 is absent.

16. The method according to Claim 13, wherein said X is O or S, n is 0 or 1, R^6 and R^7 form a fused aromatic ring $-R^{11}=R^{12}-R^{13}=R^{14}-$ wherein R^{11}, R^{12}, R^{13}, and R^{14} are independently selected from the group consisting of hydrogen, C_1-C_6 alkyl group, $-OR^8$; R^4 and R^5 are independently a C_1-C_6 alkyl group or a CYCLIC SUBSTITUENT.

17. The method according to Claim 13, wherein said method further comprises heating said sample prior to combining with said staining solution, or heating combined sample and staining solution mixture.

18. The method according to Claim 13, wherein said method further comprises removing, destroying, or dispersing below the critical micelle concentration any biological membranes that are present in said sample.

19. The method according to Claim 13, wherein said method further comprises adding an anionic detergent to the sample, staining solution or combined sample and staining solution mixture.

20. The method according to Claim 13, wherein said method further comprising electrophoretically separating said sample before, after, or while it is combined with said staining solution.

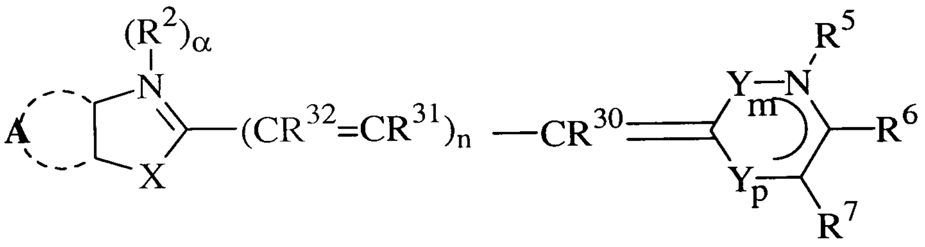
21. The method according to Claim 20, wherein said matrix is a polymeric gel.

22. The method according to Claim 21, wherein said gel is a polyacrylamide gel.

23. The method according to Claim 22, wherein said method further comprises adding an additional detection reagent to said sample, said staining solution, or combined sample and staining solution mixture.

24. The method according to Claim 20, wherein said method further comprises transferring said sample to a solid or semi-solid matrix before or after combining with said staining solution.

25. A method for the detection of nucleic acids in a sample, wherein said method comprises: a) combining said sample with a staining solution, wherein said staining solution comprises one or more dyes having formula



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wherein Rx is a reactive group; Sc is a conjugated substance; and L and BRIDGE are independently a single covalent bond, or a covalent linkage;

X is O, S, Se, NR^{15}, or $CR^{16}R^{17}$, where R^{15} is H or an alkyl group having 1-6 carbons; and R^{16} and R^{17}, which may be the same or different, are independently alkyl groups having 1-6 carbons, or R^{16} and R^{17} taken in combination complete a five or six membered saturated ring;

R^2 is selected from the group consisting of –L-Rx, -L-Sc, TAIL, BRIDGE and an alkyl group having 1-6 carbons that is optionally substituted by sulfo, carboxy, amino, substituted amino or substituted ammonium, wherein α is 0 or 1; and TAIL is a heteroatom-containing moiety;

Y is -CR^3=CR^4- wherein p and m = 0 or 1, such that p + m = 1;

R^3, R^4, R^6, and R^7 are independently selected from the group consisting of hydrogen, a C_1-C_6 alkyl, a halogen, a CYCLIC SUBSTITUENT, -OR^8, -SR^8, -(NR^8R^9), TAIL; BRIDGE, -L-Rx and –L-Sc; where R^8 and R^9 are independently a C_1-C_6 alkyl group, 1-2 alicyclic or aromatic rings; or R^8 and R^9 taken in combination are -$(CH_2)_2$-V-$(CH_2)_2$- where V is a single bond, -O-, -CH_2-, or -NR^{10}-, where R^{10} is H or an alkyl having 1-6 carbons;

wherein CYCLIC SUBSTITUENT is a substituted or unsubstituted aryl, heteroaryl or C_3-C_{10} cycloalkyl;

or R^6 and R^7 form a fused aromatic ring –R^{11}=R^{12}–R^{13}=R^{14}– wherein R^{11}, R^{12}, R^{13}, and R^{14} are independently selected from the group consisting of hydrogen, C_1-C_6 alkyl group, -OR^8, -SR^8, -(NR^8R^9),a CYCLIC SUBSTITUENT, TAIL, BRIDGE, -L-Rx and –L-Sc;

R^5 is independently selected from the group consisting of a C_1-C_6 alkyl group, a CYCLIC SUBSTITUENT, TAIL, BRIDGE, -L-Rx and –L-Sc; or R^5 is absent;

R^{30}, R^{31}, and R^{32} are independently selected from the group consisting of hydrogen, C_1-C_6 alkyl, C_3-C_{10} cycloalkyl, aryl, and heteroaryl, wherein n = 0, 1 or 2;

wherein, BRIDGE, when present, is bound to a compound having formula I or another unsymmetrical cyanine dye;

b) incubating said sample and said staining solution for a sufficient amount of time to form a dye-nucleic acid complex;

c) illiminating said complex with an appropriate wavelength whereby the presence of said nucleic acid is determined.

26. The method according to Claim 25, wherein said X is O, n is 0, R^2 is a methyl group and R^6 and R^7 form a fused aromatic ring $-R^{11}=R^{12}-R^{13}=R^{14}-$ wherein R^{11}, R^{12}, R^{13}, and R^{14} are independently selected from the group consisting of hydrogen, C_1-C_6 alkyl group, -OR^8.

27. The method according to Claim 26, wherein said R^5 is a CYCLIC SUBSTITUENT that is an aryl group and R^4 is an alkyl group.

28. The method according to Claim 26, wherein said R^5 is an alkyl group and R^4 is a CYCLIC SUBSTITUENT that is an aryl group.

29. The method according to Claim 26, wherein said compound is substituted by at least one TAIL substituent.

30. The method according to Claim 29, wherein said TAIL is according to formula LINK-SPACER-CAP;

wherein LINK is single covalent bond, an either linkage (-O-), a thioether linkage (-S-) or an amine linkage (-NR^{20}-); where R^{20} is hydrogen, C_1-C_8 alkyl or SPACER-CAP;

SPACER is a covalent linkage; and,

CAP is $-O-R^{21}$, $-S-R^{21}$, $-NR^{21}R^{22}$ or $-NR^{21}R^{22}R^{23}$; where R^{21}, R^{22}, and R^{23} are independently selected from the group consisting of hydrogen, C_1-C_8 alkyl and a C_1-C_8 cycloalkyl wherein said alkyl or cycloalkyl are optionally substituted by one or more substituents selected from the group consisting of halogen, hydroxyl, C_1-C_8 alkoxy, amino, carboxy, sulfo and phenyl where said phenyl is optionally substituted by one or more substituents selected from the group consisting halogen, hydroxyl, C_1-C_8 alkoxy, amino, C_1-C_8 aminoalkyl, C_1-C_8 sulfoalkyl and C_1-C_8 carboxyalkyl; or one or more R^{21}, R^{22}, and R^{23}, taken in combination with R^{20} and SPACER, or with SPACER alone, forms a 5- or 6-membered ring.

31. The method according to Claim 30, wherein said R^4 or R^5 is independently a TAIL or a CYCLIC SUBSTITUENT substituted by TAIL.

32. The method according to Claim 31, wherein said R^4 is a TAIL and R^5 is an alkyl group.

33. The method according to Claim 32, wherein said CAP is $-NR^{21}R^{22}$ where R^{21} and R^{22} are independently C_1-C_6 alkyl groups.

34. The method according to Claim 32, wherein said CAP is $-NR^{21}R^{22}R^{23}$ where R^{21}, R^{22} and R^{23} are independently C_1-C_6 alkyl groups.

35. The method according to Claim 31, wherein said R^5 is a CYCLIC SUBSTITUENT that is an aryl or heteroaryl and said R^4 is a TAIL where CAP is $-O-R^{21}$ or $-S-R^{21}$.

36. The method according to Claim 31, wherein said R^5 is a TAIL.

37. The method according to Claim 36, wherein said CAP is $-NR^{21}R^{22}R^{23}$ where R^{21}, R^{22} and R^{23} are independently C_1-C_6 alkyl groups.

38. The method according to Claim 26, wherein said nucleic acid is in solution, immobilized on a solid or semi-solid matrix, or present in a biological structure.

39. The method according to Claim 38, wherein said solid or semi-solid matrix is a polymeric gel, an array, a glass slide, a polymeric microparticle or a membrane.

40. The method accoridng to Claim 39, wherein said gel is an electrophoretic gel that is an agarose gel.

41. The method according to Claim 38, wherein said biological structure is a biological cell or portion thereof, virus particle or tissue section.

42. The method according to Claim 41, wherein said biological structure is a cell or portion thereof.

43. The method according to Claim 38, wherein said nucleic acid is in solution that is free from cells or portions thereof.